I. C. 7020 June 1938

UNITED STATES
DEPARTMENT OF THE INTERIOR
HAROLD L. ICKES, SECRETARY

BUREAU OF MINES
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INFORMATION CIRCULAR

REDUCING COST OF WORKMEN'S COMPENSATION IN THE MINING INDUSTRY

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D. HARRINGTON

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UNITED STATES DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

REDUCING COST OF WORKMEN'S COMPENSATION IN THE MINING INDUSTRY[1]

By D. Harrington[2]

In this period of generally increasing taxes of various kinds, one hears less complaint by mining companies about the high cost of workmen's accident compensation than was the case a few years ago, the reason perhaps being that other and more pressing phases of the tax problem now overshadow the heavy expenditures for compensation premiums which a few years ago were considered a severe burden on the mining industry. Nevertheless, the financial expenditures of the mining industry in higher compensation benefits and hospitalization or in higher premium rates, or both, instead of being less have actually increased in many States in the past year. In the spring of 1937, proposals for increased benefits to injured employees in compensation, hospitalization, or medical aid were actively before legislatures in California, Connecticut, Georgia, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, Massachusetts, Michigan, Minnesota, New Mexico, Oregon, Pennsylvania, South Carolina, Texas, Utah, Washington, Wyoming, and possibly other States. In some cases, the proposed increases in benefits were so much greater than expenditures for similar items in the past that premium rates per $100 of pay roll would almost certainly rise sharply. At this same time, occupational-disease-compensation coverage also was under consideration by legislatures in Arkansas, California, Delaware, Idaho, Indiana, Kansas, Massachusetts, Michigan, Minnesota, Montana, Nebraska, New Jersey, Ohio, Pennsylvania, Tennessee, Utah, and Washington. Sooner or later (and probably within the next few years) occupational-disease compensation will be accorded practically as wide recognition as accident compensation receives at present, and, unquestionably, mining in all of its branches will be affected more or less drastically. Hence, the present outlook is that the mining industry, in company with practically all other industrial activities, will be confronted by materially higher compensation costs than those of the past or the present, to which rather violent exception has been taken, at least in some States and at some times.

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Presented before the Metal Mining Convention and Exposition, American Mining Congress, September 9, 1937, Salt Lake City, Utah.

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It cannot be said truthfully that conditions as to workmen's compensation, either with respect to accident or disease, are satisfactory at present to those most intimately concerned, namely, the workers and the employers. Moreover, conditions are anything but ideal from the viewpoint of the general public, which, too, has a vital concern in the matter. One can at least infer, also, that the insurance companies , whether operated by the nation, the States, or private persons, are not always entirely satisfied; otherwise there would not be the more or less continual raising of, or threat to raise, premium rates, or the imposing of new restrictions, or of refusing to handle certain types of risks, mining being one in many cases.

The injured worker who receives $4 or $5, up to $25 per week, or the one who is given approximately 50 percent of his wages and finds that he is not paid for the first week or that payments stop at end of a month, is not likely to be at all well satisfied, especially if he has a family to support or is at all ambitious; and certainly the receipt of $1,000, $2,000, or some similar sum, for loss of an eye or an arm or a leg does not begin to "compensate" the victim either for the pain and suffering or the handicap that confronts him for the rest of his life. In fact, a good-sized book could be written about the numerous inadequacies of present day compensation payments to injured persons.

The employer who is confronted with a rigid charge of $2, $3, and up to $15 (and in some cases, as in tunneling, to $35) per $100 of payroll for compensation premiums certainly does not feel "happy", and this is especially true where he knows that his particular property has, through his efforts in cooperation with others in his employ, reduced the actual outlay for accidents to but 50 percent (or in some cases as low as 10 percent) of the amount that must be paid in premiums. The public certainly does not feel at all well satisfied when the maimed workman has spent the $1,000, or $2,000 or even $5,000 received in compensation from some permanent injury and later on loses his job and is thrown on the city or county for support for the rest of his life; nor does the public like the burden of taking care of the family of a dead mine worker in one manner or another after the compensation of approximately $2,000 to $5,000, paid to the "beneficiaries", is spent.

On the other hand, and notwithstanding all of the admitted imperfectio of present-day compensation laws and their enforcement, conditions, viewed broadly, are far superior to those that existed 30 years ago or before workmen's compensation laws were in effect in the United States. To be sure, many of our mining companies and their employees are still resentful over the fact that in many (probably most) instances it requires the expenditure of $2 or more on part of the employer to place $1 of compensation benefits in the hands of the injured workman. Admittedly, this situation is not ideal or even satisfactory, but it is a vast improvement over the pre-compensation-law period when, through the intervention of ambulance-chasing lawyers and some scarcely less reprehensible members of the medical profession, the employer was almost inevitably forced into a position of antagonism to the injured employee with whom he naturally would like to be friendly and helpful. Under the very unsatisfactory conditions then in vogue, very often it required expenditure of $10 or more by the employer to place $1 of relief or compensation in the hands of the injured person, the remainder of the $10 being absorbed in various fees and expenditures that went into the pockets of lawyers, doctors, witnesses, and others who had no fundamental right to enter into the matter at all. In addition to this dismaying and gross waste of industrial funds, there was a much worse source of industrial waste and inefficiency under the pre-compensation-law period in the continued and deeply ingrained antagonisms and distrust fomented almost invariably by the pitting of employer against employee just as soon as the latter sustained an injury. For the removal of this inefficiency and strife, the compensation laws deserve much credit even though they are as yet by no means perfect.

Compensation insurance can be judged from numerous points of view, and unfortunately it is largely due to this fact that so much is left to be desired in its operation in almost every State in the Union. It would appear that the first consideration should be the giving of readily available funds or other relief to injured industrial employees or to their dependents in case death occurs to the victim; and it would appear that this relief should be forthcoming whether the victim is or is not at fault in connection with the accident. Then, too, the employer who, under present-day compensation procedure, is forced to sustain the cost of the relief measures in employee accidents should most certainly be protected against drastic court or other action in connection with an accident unless it can be proven that he or his organization is unduly or criminally negligent. This is particularly desirable in case of a serious disaster that might force insolvency or bankruptcy. And, finally, it is certainly not right or just to force an employer whose mine or plant does a good job of accident prevention to shoulder directly or indirectly the burden of the mine or plant that neglects or disregards reasonably safe procedure and practices.

Safety experts are definitely of the opinion that the compensation laws should be so framed and operated that they will give impetus to the prevention of accidents. In this the experts are rather bitterly disappointed in many (probably in most) States because it is readily apparent that under the provisions of the compensation acts the industrial organization that efficiently prevents accidents is penalized by being forced to pay essentially the same compensation premium rate as does another organization that does relatively little (sometimes practically nothing) to prevent accidents. While it is realized that the subject of insurance is highly technical and complex and one on which the layman can easily "stub his toes", it certainly appears that compensation insurance should be kept removed as far as possible from the "profit motive." This would appear to make it imperative that the State or Federal Government should take over this part of the insurance industry and administer the provisions of the (State or Federal) compensation insurance acts in such manner that practically all

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funds paid by employers as premiums or otherwise for compensation insurance are available for the benefit of the victims of industrial accidents, even if the cost of administration must be borne by the general public through the agency of taxation. With equal certainty, the insurance acts should be so administered that the employer who really tries to reduce accidents and has a good or low accident record should be given a lower premium rate, and that the careless or indifferent employer be penalized by a higher rate for his poor safety practices and results.

Fixing of compensation premium rates in most States is a relatively rigid operation, usually founded upon experience of several years, and one that can be utilized only to a very limited extent for relief from any burdens (real or imaginary) now confronting those who pay supposedly high premium rates for compensation insurance. Hence, suggestions as to reduction of compensation costs to most of those carrying State or commercial compensation insurance must necessarily be in connection with long-time procedure, except in the relatively few States where some form of merit rating is in effect. Many States, however, allow carrying of insurance by concerns operating industrial establishments, including mines, that can show ample financial strength; here is where definite progress can be made if the right kind of procedure is followed. Practically the only readily available and really satisfactory method of reducing compensation costs at present is through the prevention, or at least the reduction, of accidents, and this is not only possible but very readily feasible.

Everyone should look upon safety, whether in mining or in any other walk of life, primarily from the humanitarian standpoint, as the prevention of loss of life and limb with its attendant suffering is a goal well worth almost any expendable effort. Unfortunately, however, human nature is so constituted that constant and universal application of highminded principles to the prosaic features of industrial work is not and probably never will be obtainable. It is now evident to those most experienced in accident-prevention work that safety is likely to be achieved and "safety dividends" declared only when the officials in charge of mining or of other types of industrial projects actively support and encourage safety programs, and generally, although not invariably, the attitude of mining-company executives can be interpreted in only one manner - safety expenditures must show a dollars-and-cents return on the investment. Although this is rather cold-blooded, perhaps it is logical, as industry must return a profit if it is to continue in existence under our present economic system; hence, if safety is to be given any appreciable attention, it must also show a profit. Safety directors and safety workers, as well as some operating executives, especially those in immediate contact with the mine and its personnel, usually consider saving in human life and suffering sufficient justification for spending money on safety, even if the company should receive no immediate dollars-and-cents return; but to the surprise of most safety workers and local operating officials, a rigid accounting frequently reveals that so-called philanthropic expenditures for health and safety in mining have also paid large dividends in money.

In general, mining is carried on underground, that is, in confined places where it is difficult to obtain adequate lighting, and frequently in rock strata requiring much care to prevent caving or falling of overlying material. Explosives must be used in mining with the numerous hazards associated with them, and some mines give off explosive or irrespirable gases. Machinery must also be used, usually under conditions much more hazardous than on the surface. These and many other considerations cause mining to be probably the most hazardous occupation in which large numbers of persons are employed, in the United States as well as in most other important civilized countries.

Prevention of accidents in the mining industry is far more complicated than in surface industrial work, even of the more hazardous types, because the different elements that enter into possible accident occurrence are ascertained more readily above ground and suitable action can be taken against them. Moreover, errors in connection with prevention of accidents in surface industrial work usually affect only one, or possibly, a few persons, while in mines one human error may readily cause an explosion or other untoward occurrence resulting in the death of scores or even hundreds of persons.

This difficulty in the prevention of accidents in and around mines is well-known, and most countries and States have regulations to guard the safety and, to a much smaller extent, the health of workers in mining and allied industries. At best, the State laws and regulations regarding the welfare of mine workers are merely a skeletonized outline of some more or less fundamental minimum requirements and are far too general to do much more than suggest some procedure which may or may not be safe or healthful; most of them are grotesquely out-of-date as applied to present-day conditions, and none of them is adequate to protect life, limb, health, or property.

For many years progressive mining companies in the United States have not been satisfied to operate only within the meager safety requirements of the State laws or regulations and have adopted additional and far more effective safety procedures of their own, although complying also with the State laws and regulations. As a result of this forward-looking policy, many of these companies have made astonishing progress in the reduction of accidents. This is true of bituminous-coal and anthracite mines, metal mines, nonmetallic mineral mines, coking plants, milling, smelting, and metallurgical establishments, and the various activities in connection with the production and processing of petroleum. Some mines have worked 25 years or more without a fatal accident; others have worked with a considerable number of men a year or more without a lost-time accident. One surface metal-mining operation produced more than 75,000,000 tons of rock and ore without a fatality, a surface coal property handled over 90,000,000 tons of rock and coal without a fatality, another underground mine produced over 15,000,000 tons of ore without a fatality, and numerous individuals have worked 50 or more years in mines without having sustained any accident which would prevent their working at their own jobs on the next regular shift.

The cost of maintaining adequate safety in a mining property, although considerable, is certainly not excessive, but, with equal certainty, the ultimate cost of neglecting safety in and around mines is heavy, not only on the operating company and its employees but also on the entire community.

From 15 to 17 cents per ton seems reasonable as the total present-day cost of coal-mine accidents. Inquiries also have been made as to the cost of preventing accidents, but definite data are not readily obtainable, as far too many conflicting elements enter into the cost of conducting coal mines to segregate effectively all of those features that pertain to safety. Logically, safety enters very definitely into supervision, ventilation, haulage, timbering, blasting, etc., as well as rock-dusting, first aid, safety organization, safety meetings, and other similar items; however, such items as supervision, ventilation, timbering, haulage, and blasting are an integral part of mine operation, as manifestly no reasonably efficient coal mine under present-day conditions could be worked without these and other functioning agencies or departments. In some coal mines rock-dusting is recognized as one of the main operating functions, and in many mines rock-dusting is assessed against operating costs, just as are ventilation, haulage, drainage, blasting, etc. This is as it should be, and all nonanthracite coal mines should be required to rock-dust as routine daily operating procedure

While the entire operating personnel, including all officials and workers, certainly should partake actively in accident-prevention activities, up-and-coming organizations have realized for the past several years that "what is everybody's business is nobody's business", and that accident-prevention work must be placed in a specific department if accidents are actually to be prevented. Since real accomplishment in maintaining safe operation of mines depends largely on the safety department, it seems fair to take as the cost of accident-prevention work in a coal mine the expenditures for this department and its activities. It should be kept in mind, however, that much safety work, the cost of which goes into the regular working accounts, is done by the operating departments, but that through safety of operation, efficiency is increased and costs are lowered.

Figures show that the safety department and its activities cost from 0.5 cent to 1.5 cents per ton of coal mined, and that about 1 cent per ton of coal is a fair average. This is equivalent to an average of about $1 per $100 of pay roll. The latter figure applies, also, to all types of metal and nonmetallic mineral underground properties, but the cost for quarries and open-cut mines should be considerably less. The cost includes the salaries of safety inspectors; the cost of posters, first-aid equipment, etc.; the expense of training all men in first aid; and the financing of periodical safety meetings and possibly of a sectional first-aid contest annually.

However, many coal mines now hold their compensation costs well under 1 cent per ton, and scores of coal, metal, and nonmetallic (both open-pit and underground) mines now have compensation, hospitalization, and medical costs of less than 25 cents per $100 of pay roll; many mines have operated for a year or more, in some instances 4, 5, or 6 years, without a lost-time accident, hence with compensation charges essentially nil.

Numerous records at hand make it appear that reducing accident occurrence (including frequency, severity, and cost) as much as 90 percent within a few years through well-directed accident-prevention activities in the mining and allied industries is by no means unusual, and this would appear to warrant a statement that at least 75 percent of the accidents in and around our mines and mining plants could be prevented. That this is not an absurd assumption or one not feasible of accomplishment is substantiated, at least somewhat, by the following statement taken from an interesting publication entitled Tendencies In Workmen's Compensation, issued by the United States Chamber of Commerce:

> It is not uncommon to find industrial plants over a short period of years reducing accidents from 75 to 90 percent, and there are many plants which have records of several million man-hours without a lost-time accident. ***. The cement industry, which leads all others in point of accident reduction, has made a remarkable record. Of 150 cement plants, located in all parts of the United States and Canada, 45 finished a recent year without a single lost-time accident among their thousands of employees.

This pamphlet also contains the following rather significant statement:

> Workmen's compensation has been a constant factor in stimulating accident-prevention work.

It appears that compensation for accidents is in anything but a satisfactory condition, even though in many particulars the situation is better than it was in the past; it also appears to be almost impossible ever to obtain really satisfactory results through payments in connection with occurrence of accidents, and about the only really effective approach to getting at least a measure of relief is to prevent accidents or at least reduce them to a minimum. It has been proven that present-day accident occurrence is far too high, and that in the opinion of careful, competent observers it can be reduced 75 percent or more. If this is done (and undoubtedly it can be done), it will automatically remove at least some of the burden of compensation from the shoulders of the employer and take some of the sting of its inadequacy from those who receive the compensation after having incurred injury. In order to bring about this greater safety, some suggestions are made here, which, if kept in effect by all engaged in mining, should aid materially in reducing the occurrence of accidents in and around mines.

All officials of mines should be familiar with Federal, State, or local laws and regulations as to health and safety in and around mines, as well as with the health and safety rules of the company, and should enforce them to the best of their ability.

Every mine should have available printed or multigraphed rules, preferably in pocket-pamphlet form, specifying the operating company's minimum safety requirements at the mine. Specific instructions should be given in this pamphlet (in as many languages as may be necessary) to every class of mine labor, including foremen, shift bosses, safety men, miners, drivers, hoistmen, trackmen, timbermen, electricians, etc., as well as to the various types of surface workers, in order to convey to both officials and workmen the minimum requirements of the company as to health and safety. It should be made clear that these are minimum requirements and that others may be added from time to time or may be issued verbally.

Every mine should have a staff of officials sufficient to make at least two inspection trips daily to every working place in the mine, with plenty of time for a careful safety inspection of the place and to be certain that unsafe conditions or practices are remedied without delay. In general, there should be fewer than 50 underground employees for each supervisory official.

Preferably, all superintendents, foremen, safety inspectors or bosses of any kind in charge of underground workers should have a certificate of competency, and in general these certificates should be issued by the State after the applicant has passed a rigid examination showing that he is competent to perform the duties of his position. If the State does not issue certificates, the examination and certification should be made by the operating company. The certificate should expire 5 years from date of issuance and should be renewed only after the holder has again passed an examination showing that he has kept informed on up-to-date safety practice and thought.

Every underground mine should keep, in a safe and quickly accessible place on the surface, a record that will show the time when each person goes into the mine and when he comes out, and that will also show, in so far as practicable, where he may be found while in the mine.

Every mine or mining plant employing 25 or more persons should have a full-time safety man or at least some person, one of whose main functions should be safety work. He should preferably have technical training and several years of experience in mining, should have authority to require immediate execution of safety instructions, and preferably should be employed by and report to the highest company officials. One of his duties should be to train every person in and around the mine or plant or have them trained in an up-to-date course in first-aid to the injured and to see that every person in the organization keeps well trained in first aid. The safety man should make a safety inspection and written report on the mine at least once a month. The report should contain summarized conclusions and recommendations, a copy should be sent to the highest operating official of the company as well as to the mine foreman or superintendent, and preferably the report and its recommendations should be discussed in the next safety meeting following the date of completion of the report. Safety meetings should be held at least once a month with participation by both officials and workers.

Workers in mines should be made acquainted with the State laws and regulations as to safety as well as the company's safety rules and should be required to obey them. Failure to obey State safety laws or regulations or company safety rules should subject the offender to prosecution by the State or to discipline by the company, or to both.

Every person employed in or around any mine should take the United States Bureau of Mines' full course of training in first aid to the injured. All mines should be provided with competent medical and surgical service and with suitable hospital accomodations for injured persons. The safety department should keep in close touch with the personnel and medical departments as well as the operating department in helping to rehabilitate injured persons and restore them to suitable work as soon as is consistent with humane procedure.

Protective wearing apparel, such as hard hats, gloves, goggles, safety shoes, etc., should be worn where the occupation is of such nature that specified equipment or apparel is known to be advantageous in the avoidance of accidents or ill health. As a minimum, all persons in and around the mine should wear hard hats and safety shoes.

For the protection of the employee and the employer, as well as for the best interests of the general public, every person employed in or around any mine should, before employment and annually thereafter, undergo a complete physical examination under methods and conditions that will insure that the data thereby obtained are used only for the forwarding of health and safety. All persons in and around mines should be given eye examinations at least annually and be required to wear goggles with lenses ground to correct defects of vision. Deaf persons should not be employed in mines.

Every feasible effort should be made to reduce the amount of dust and harmful gases in the air of underground working places and faces to an absolute minimum in all kinds of mines. Certainly, no dry drilling should be done in rock in any underground mine.

Every mine should have a mechanically controlled ventilation system with the main intake-air course in a separate opening from the return-air course, and with the main ventilating fan preferably on the surface and so installed that the direction of air can be reversed with little or no loss of time.

Preferably, the man-hoisting or traveling mine opening or openings should be on intake air. Every mine should be so ventilated that the air of working places shall at all times be kept free of gases, dust, and of temperatures and humidities dangerous to safety and health. (Explosive gas (methane) should not exceed 1-1/2 percent, oxygen should not be less than 19 percent, and carbon dioxide should not exceed 1 percent. No appreciable percentages of poisonous gases, such as carbon monoxide, hydrogen sulphide, oxides of nitrogen, etc., likely to be found in fumes from blasting, should be allowed, and provision should be made to have a sufficient quantity of pure circulating air to keep dangerous quantities of finely divided dust from the air breathed by workers and, if possible, to maintain temperatures below 80°F. (or preferably below 75°F.), especially if relative humidity is above 90 percent. There should be at least 2,000 cubic feet of air per minute passing through every working place and, preferably, past every working face.)

While driving tunnels or drifts and sinking or raising shafts or slopes, and also in their operation, there should be an adequate ventilating current wherever men work or travel.

Every underground mine should recognize the danger of even a small underground fire and should have plans made and on record, in typed or printed form, as to procedure in case of fire at any of various places in the mine, but with particular reference to procedure in case of fire in combustible structures at or near the collar of the main hoisting shaft or in the shaft itself (in a shaft mine).

All shafts and all inclines with pitch above 30° should have along or in them a system of fire doors such that by closing doors the shaft or incline can be isolated from any or all levels or other openings leading to or away from the mine workings.

All underground mines should have a system of fire doors so placed as to be capable of isolating practically any main working section of the mine in case of fire. All mines should have an underground water system with suitable arrangement for prompt and efficient use in case of occurrence of fire in any part of the mine.

Internal-combustion engines should not be used in any part of a mine or in tunnels under construction; most certainly, none should be used unless the velocity of the air current in the place is more than 100 linear feet per minute and toxic gases are always kept less than 0.02 percent in the air current, and also unless the percentage of inflammable gas in the air current is less than 0.25 percent.

All mines should establish and announce to employees, in printed or other similar manner, a systematic method of timbering suitable to the individual mine, defining the minimum spacing of supports and allowing for additional supports where there is thought to be a necessity for them.

An ample supply of the necessary sizes and lengths of timber to keep working places safe should be available at all times to all working places; preferably, mine timbering should be done by well-qualified full-time timbermen.

At every entrance to every shaft, there should be a strong, tight gate or door, which closes automatically and is always kept closed except when the cage or skip is at the opening; the door or gate should be so constructed that it will prevent falling of men or material into the shaft. Every cage that transports men should be provided with a tight gate as well as with suitable hood and sides to prevent men from falling into shaft timbers and to prevent material from falling on men in the cage.

Blasting should not be done during the working shift because it throws enormous quantities of finely divided dust as well as considerable amounts of poisonous gases and some explosive gases into the air. In addition, it has a definite tendency to heat the surrounding air and to shake down loose overhead or side material, and, in coal mines, it is likely to initiate explosions. Places in which blasting is done should be wet down thoroughly previous to firing of the shots and also immediately upon return of men to the face after the shots have been fired; in general, unless ventilation is very effective, it is inadvisable to return to the face in less than an hour after blasting. Preferably, blasting should be done by or under the immediate supervision of a shot-firer having a certificate of competency indicating that he is expert in the handling and use of explosives.

Adequate clearance should be provided on all underground haulage roads for the protection of persons who must work or travel in those places. There should be a continuous space for travel on at least one side of the trackway, with a clearance of 30 or more inches between the nearest obstruction and the farthest projection of any moving equipment; or there should be holes that may be used for shelter, suitably marked, unobstructed and not over 60 feet apart on the traveling side, not less than 3 feet deep, 5 feet wide, and 6 feet high, or as high as the traveling space, if that is less than 5 feet. Haulageways should be kept clear of obstructions, such as piles of dirt, mud, coal, rock, etc., as well as loose timbers or rails or piles of timber or rails or other supplies.

Preferably, mine cars should have solid sides, ends, and bottom, and no cracks, holes, or other places for leakage of material from mine cars should be allowed.

Electrical equipment used in and around mines or mining plants should be of the inclosed, non-arcing, or permissible type wherever feasible, should be installed in a safe, careful manner, and kept in good repair. All bare power lines carrying 100 or more volts in or around mines or mining plants, wherever they are less than 7 feet above the floor or footwall or the track rail should be adequately safeguarded throughout their entire length against contact by persons or animals.

All moving parts of mechanical equipment used in or around mines or mining plants should be kept adequately guarded, and all such equipment should be kept in good repair.

Adequate lighting should be provided at all places where men work; preferably, the portable lights for underground workers should be permissible electric hand or cap lamps, and no open lights or smoking should be allowed.

Every underground mine and every part of every mine in which 10 or more persons work should have two or more ways of escape to the surface so arranged and equipped that men can escape quickly. Where the mine exits are shafts or inclines with pitch over 45°, there should be man-hoisting arrangements in at least two openings if the depth is greater than 300 feet.

Openings into abandoned mines or parts of mines should be adequately sealed or protected against entrance of persons or animals, or to prevent contamination of the air of working parts of mines; exceptions may be made to this requirement in order to allow for ventilation or escape through abandoned mines or parts of mines. Abandoned or unventilated mines or parts of mines should not be entered without taking adequate precautions to make certain that the air of the place is respirable.

All accidents in and around mines and mining plants should be reported to an appropriate governmental agency. The accident reports should be compiled and studied at the mine and steps taken to try to prevent recurrence of any accident that has been investigated. It is important that every accident that occurs in a mine be studied carefully. The following additional suggestions are applicable chiefly to coal mines:

Every mine should be given a rigid safety examination by a competent certified official or officials within 2 hours of the entrance of the oncoming shift.

All lignitic or bituminous coal mines that are not wet should be kept adequately rock-dusted in all accessible parts, except that the face region should be kept wetted by hose and water or otherwise for a distance of approximately 40 feet from the face.

Wherever possible, coal should be cut rather than shot off the solid; and machine cuttings should be wetted as the cutting is done.

All underground blasting should be done with permissible explosives fired electrically by shot firers who have a State certificate of competency, and preferably while the working shift is out of the mine.

New electrical equipment installed in coal mines should be entirely of permissible types, and all open-type electrical equipment should be gradually replaced by permissible types.

Electrical equipment in mines should be given rigid inspection at least weekly, and defects should be repaired promptly. A written record of the defect as well as the date and manner of repairing should be kept.

No open flame of any kind should be allowed in coal mines during the working shift; blow torches and welding equipment should be used underground only when all other workers are out of the mine.

Mines that give off methane should preferably have two main fans, one of which is in reserve; there should be more than one source of power for the main fan.

All underground bituminous and lignitic mines should be divided into air splits, with a minimum of 10,000 cubic feet of air per minute in any split. There should be definite moving currents of air at and past all working faces.

All crosscut openings except the last one nearest the face should be closed or stopped off, and the stoppings in crosscuts between entries should be proof against fire or leakage.

Doors used in mines should be tight, self-closing, and of fire-resistant material; if feasible, air circulation in mines should be controlled by fire-proof stoppings, overcasts, and regulators rather than by doors.

Where possible, room and pillar coal mining should be conducted so that pillars can be "pulled", and they should be started back immediately upon completion of the adjacent rooms, with a predetermined pillar line kept intact. Pillars should be pulled "clean", leaving few, if any, stumps; and cribs, props, and other supports, as far as feasible, should be removed or blasted out before final retreat.

Preferably, not more than 200 persons should be employed underground at one time in any bituminous or lignitic coal mine.

CONCLUSION

Workmen's compensation costs, like other taxes, are by no means easy to reduce, and this applies to the mining industry at least as definitely as to any other industrial activity. While the tendencies are definitely towards increasing cost of workmen's compensation, and efforts to stem this tide are very likely to be productive of little of value, on the other hand, there is one readily feasible even though somewhat difficult course open to the industrialist (and this applies very definitely to those engaged in the mining and allied industries), namely, that accident occurrence can, by the use of the right kind of procedure, be reduced at least 75 per cent (possibly as much as 90 percent); and if accidents are prevented from occurring, manifestly there will be no necessity to pay compensation for them.